



## Full length article

Evaluating the legibility of decorative arabic scripts for *Sultan Alauddin* mosque using an enhanced soft-computing hybrid algorithm

Ahmadreza Saberi <sup>a</sup>, Shervin Motamedi <sup>b,c,\*\*</sup>, Shahaboddin Shamshirband <sup>d,\*</sup>,  
Cecilia Lewis Kausel <sup>e</sup>, Dalibor Petković <sup>f</sup>, Esmawee Endut <sup>a</sup>, Sabarinah Sh Ahmad <sup>a</sup>,  
Roslan Hashim <sup>b,c</sup>, Chandrabhushan Roy <sup>b</sup>

<sup>a</sup> Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Shah Alam, 40450, Malaysia

<sup>b</sup> Department of Civil Engineering, Faculty of Engineering, University of Malaya, 50603, Kuala Lumpur, Malaysia

<sup>c</sup> Institute of Ocean and Earth Sciences, University of Malaya, 50603, Kuala Lumpur, Malaysia

<sup>d</sup> Department of Computer System and Technology, Faculty of Computer Science and Information Technology, University of Malaya, 50603, Kuala Lumpur, Malaysia

<sup>e</sup> Interior Architecture, Mount Ida College, Newton, MA, 02459, USA

<sup>f</sup> University of Niš, Faculty of Mechanical Engineering, Department for Mechatronics and Control, Aleksandra Medvedeva 14, 18000, Niš, Serbia

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## ABSTRACT

Ornamental calligraphy features sacred inscriptions in mosques as an integral part of its interior design. This study analyzes the legibility of these Arabic scripts for Malaysian users of mosques, implementing for the first time a quantitative tool for this effort, the ANFIS method. Our purpose is to identify the most influential parameters affecting the readability and understanding of various decorative Arabic scripts. Mosques have important roles in social life and in teaching the Islamic faith to Muslims. We conducted a questionnaire survey handed to the public attending the *Sultan Alauddin* mosque in Selangor, Malaysia. We subjected the data resulting from this survey to the ANFIS method (the adaptive neuro fuzzy inference system), to identify measurable parameters that play a role in the ability to read decorative Arabic scripts. The ANFIS process for *variable selection* was implemented in order to detect the predominant variables among the parameters identified. We analyzed how demographic aspects and cognitive skills relate to the ability to correctly interpret these scripts. The results indicated that of the parameters examined, the ability to read Arabic is the one that influences the most, the correct interpretation of ornamental inscriptions of mosques, and the best predictor of accuracy.

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## 1. Introduction

The word “mosque” derives from “*masjid*”, an Arabic utterance that literally derived from “*Sujud*” which means prostration (Hillenbrand, 1999; Hitam & Talib, 2005; Nasir, 1984). Although in the Quran the term *mosque* is equal to the place of *Allah*, it is defined as a building for Muslim worship. A mosque is the major religious core of Muslim culture for Friday and daily prayer. It facilitates communal functions such as teaching religious lessons, performing marriages, and a place for charitable donations (Zakat).

The provision of space and sitting in mosques must satisfy the religious needs of all Muslims, regardless of their gender, socio-cultural background or the mosque’s stylistic architectural parameters. Although the space for women is separated from men during daily prayers, both genders pray in the same prayer hall. However, observation indicates that the content of inscriptions varies based on its planned locations where the calligraphic ornamentations are to be displayed (Dilmi, 2014). During religious services, surrounding elements should not disturb the concentration of people during prayers. In spite of this reference, the beautification of mosques is not perceived as distracting. On the contrary, aesthetics and calligraphic ornamentations are considered integral to the architectural design of mosques to reflect the theory of Islam in practice (Anzar, 2003). Although aesthetic values and religious aspects are sometimes thought to contradict each other, if the legibility of inscriptions becomes an issue, aesthetics is ignored.

\* Corresponding author.

\*\* Corresponding author. Department of Civil Engineering, Faculty of Engineering, University of Malaya, 50603, Kuala Lumpur, Malaysia.

E-mail addresses: [shervin.motamedi@gmail.com](mailto:shervin.motamedi@gmail.com) (S. Motamedi), [shamshirband@um.edu.my](mailto:shamshirband@um.edu.my) (S. Shamshirband).

In the early phases of the spread of Islam, a mosque's architectural plan was extremely simple (Hillenbrand, 1994). The *Masjid Nabawi* or Prophet's mosque in *Medina*, one of the first Muslim establishments, was built in 7AD, after residential houses, and it included a courtyard, prayer hall and attached quarters, allocated for the Prophet's family. The first large-scale mosque was constructed later in the same century, during the second Caliph, *Umar Al-Khattab* (Hamidullah, 1986).

Nasir (Nasir, 1984) reported that Islam came to Peninsular Malaysia in the early 14th century. The evidence came from an inscribed stone found on the riverside of *Tarsat River* at *Kuala Brang, Terengganu*, in the east coast of the Malay Peninsula in the year 1887. The inscription on the stone was written in *Naskh* scripts, which is the most comfortable type of scripts in terms of readability. Besides that inscription, no other historical evidence for the early Islamic period was found either in the form of ruined structures or material remains (Ahmad, 1999; Rasdi, Tajuddin, & Utaberta, 2006). The spread of Islam to Malaya was considerably fast, being followed by the construction of a large number of mosques for religious activities. These were done following the vernacular architectural style. Since then, the concept of decoration went under the consideration of designers and engineers.

The underlying purpose of this study has been to evaluate and analyze the possibility of a new model of learning, i.e., a collaborative e-learning, in substitution for the traditional method of education used, namely Iranian calligraphy.<sup>1</sup> Previous studies have done this by way of challenging the restricted area of training that uses traditional calligraphy methods (Attaran, 2012). One of these is demonstrated by analyzing correct responses and performance-subjective ratings, that Arabic letters in square matrices (e.g.,  $8 \times 8$ ) are more readable than in rectangular matrices (e.g.,  $7 \times 9$ ) (Al-Harkan & Ramadan, 2005). Additionally, there is a new method using the C4.5 machine learning system for the recognition of Arabic texts (Amin, 2000). Further than these studies, researchers have also explored rules for Arabic typography in e-documents (Azmi & Alsaiani, 2010). Other work using ANFIS and optimization to recognize the *Devangari* script, has been attempted by Sable et al., for printing calligraphy (Sable & Nirve, 2013). Similarly, Patel et al., (Patel & Thakkar, 2014) successfully used ANFIS to recognize handwritten *Nastaliq* scripts. However, the ANFIS technique has never been applied before our study, to assess the legibility of Arabic script for readers.

In our work, ANFIS is applied to field data to select the most influential parameters affecting legibility. It studies the ability to read and understand ornamental scripts of the users of a Malaysian mosque. It should be noted that this is the first time that ANFIS technique is applied to investigate the legibility of Arabic calligraphy from readers themselves. What we attempted to create and implement is a sophisticated algorithm to output reasonably correct Arabic texts. Field data was collected by handing a questionnaire survey to the congregation of the *Sultan Alauddin* mosque of Selangor. ANFIS includes a process called *variable selection* that offers several ways of discovering a subset of the recorded parameters with good capability of prediction. The ANFIS network was used to perform a variable search and thereafter, it was used to examine how six user groups (our study's parameters) can read the following scripts: *Thuluth*, *Kufic*, *Naskh*, *Nastaliq*, and *Diwani*. The parameters analyzed were age, gender, education, area of residence, ability to read Arabic and to understand Arabic.

The remaining organization of this study is as follows: Section 2 presents historical information for the benefit of readers who are

not familiar with Malaysian mosques or the Muslim faith. It describes Arabic calligraphy, explains its origins and its importance in Mosque ornamentation. Section 3 lays out this work's experimental and simulation methods; and Section 4 presents and discusses the results and findings of this study.

## 2. Arabic calligraphy

In order to identify influential parameters in the readability of Arabic calligraphy, we proceed to briefly introduce some basics of mosque ornamentation and the scripts of our study.

### 2.1. The ornamentation of mosques

Islamic architectural ornamentation is considered a conceptual art (Clévenot & Degeorge, 2000) that inspires users through its mood. The ornament of Islamic art has always been flexible in character. It does not depend on patterns, materials or scale, and it can offer a suitable inspirational space to the faithful (Othman & Zainal-Abidin, 2011). Mosques have a role to play in society's faith and education. The ornamentation of these buildings is expected to address the basic doctrine of the Muslim community. The Quran speaks of the importance of "Beautiful Deeds", and this reflects that aesthetic conduct is an aspect of the sacred. It is commonly believed that the main reason for the ornamentation displayed in mosques is to appreciate the interior aesthetic of the mosque as a sign of God's presence. Islamic art and decorative motifs must convey the hospitality of the Muslim community (Zin, Ladjal, Hamid, Fauzi, & Grine, 2013). In this regard, sacred calligraphy expresses the remembrance of God and is widely used around the world. While this remembrance is common in other religions, Islamic religious art attempts to exhibit the beauty of God's creation in the conceptual art forms accepted by the faith. The divine can be conveyed through geometry or floral patterns; in other instances, this art is conveyed by Quranic inscriptions (Fig. 1) in the form of architectural ornamentation placed at various locations (Ali, 2001).

Arabic calligraphy is practiced at a level of fine art. It must convert the verses of the Quran and the words of the Prophet Muhammad into a visual masterpiece. The simplest style of writing used is termed *Naskh*. If the craftsman softens it and makes it angulated, it becomes another style, identified as *Kufic*. If the shape becomes intricate, stretched, thickened, overlapped and prolonged, it forms the Arabic script known as *Thuluth*. Calligraphic ornamental patterns are usually designed in three dimensions on a carved wood panel, or a stucco embellishment on a wall, complementing a floral or geometric combination. Although numerous other styles of calligraphy are used in the Middle East, (i.e. *Diwani*, *Riqa'* and *Nasta'liq*), the three above-mentioned writing styles (*Kufic*, *Naskh* and *Thuluth*) are the ones Malaysian mosques mainly apply in their interior and exterior ornaments.

### 2.2. The development of Arabic calligraphy

Islamic calligraphy arose from the development of Arabic writing and advanced to becoming art. In the art of calligraphy artists create aesthetic designs from inscriptions. In the opinion of Turgut (Turgut, 2014) calligraphy is undoubtedly the most inventive contribution of Islam to the visual arts.

Early Arabic scripts from the 7th to the 11th century can be approximately categorized into two main types, as *Hijazi* and *Kufic* (Alshahrani, 2008). After these two primary styles of Arabic letters, other scripts developed, one after the other. Scholars who study Islamic calligraphy use the term *cursive* (Fig. 2) to differentiate the group of scripts *Naskh*, *Thuluth*, *Nastaliq* and *Diwani* from the angular *Kufi* group (Amara & Bouslama, 2003; Khorsheed, 2003).

<sup>1</sup> Arabic calligraphy that originated in Iran. The message of the Quran is conveyed in Arabic language, hence the reference Arabic calligraphy is used throughout Islam.

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